

water runs out even at low tide to prevent a sand bar forming.

There is little doubt that management strategies within the Cape Range National Park will need to take account of the groundwater influence on the region not only for the direct support of the unique subterranean freshwater fauna but also for the subsequent flow into the coastal areas when the brackish groundwater maintains a last remaining pocket of a diverse mangrove system and its associated diverse fauna.

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INSECT POLLINATION IN THE CYPERACEAE

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ABSTRACT

One Australian species, *Cyperus pulchellus*, is added to the list of four species from widely separated regions and genera of the Cyperaceae, which appear to have re-adopted insect pollination.

INTRODUCTION

The Sedges (Cyperaceae, 99 genera, ca 4,000 species) and the Grasses (Poaceae, 620 genera, ca 10,000 species) are amongst the largest monocotyledon families (the others are Liliaceae, 250 genera, ca 3,700 species and the Orchidaceae, 735 genera, ca 17,000 species)

Generally members of the Cyperaceae and Poaceae, unlike the chiefly insect pollinated Liliaceae and Orchidaceae, have numerous unattractive flowers arranged in dense inflorescences and are wind pollinated. However, within both the Cyperaceae and Poaceae a number of species in different genera have apparently again adopted Insect pollination (this mode of pollination is considered ancestral for all monocotyledons, Stebbins, 1974).

The species of Cyperaceae considered to be Insect pollinated are discussed below:

(1) *Dichromena ciliata* (Fig. 1.B)

Dichromena cilata, a perennial sedge native to Tropical and Central America, has been shown to be pollinated by pollen collecting bees and flies by Leppik (1955). The attractive floral parts are the large white bracts subtending the dense terminal inflorescences, no scent or nectar being produced.

(2) *Ficinia radiata* Kunth. (Fig. 1.C)

Ficinia radiata is a perennial herb native to the Cape Province of South Africa. The inflorescences are subtended by large attractive golden yellow bracts (the flowers are also yellow). Because of its striking appearance the species has been considered as forming a monotypic genus *Sickmannia*, but is currently placed in the large genus *Ficinia* (Dyer, 1976) which is widespread in Africa.

The author has observed this species being visited by pollen collecting syrphid flies on Table Mountain. However, Everard and Morley (1973) state that *Ficinia radiata* "is native to damp plains and mountains of the Capetown and Clanwilliam areas of the South-Western Cape Province, and is noticeable for the ornamental bracts with bright glossy yellow bases which surround the inflorescence. Despite this conspicuous coloration which in most plants would serve to attract birds and insects, the small flowers, borne in a cluster at the base of the bracts are wind pollinated." They provide no data to support this statement, and I was unable to locate any information on the pollination of this species in the literature. Obviously further studies are needed on the

pollination biology of this species.

(3) *Ascolepis proteoides* Welw. var *bellidiflora* Welw. (Fig. 1.A)

This variety of this common species is confined to tropical West Africa. The numerous white bracts surrounding the inflorescences give the species a Compositae-like appearance. It seems probable that *Ascolepis proteoides* is pollinated by insects but observations are lacking (Goetghebeur, 1980, Hutchinson, 1973).



Figure 1. Species of Cyperaceae known, or suspected of being insect pollinated.

- A: *Ascolepis proteoides* var *bellidiflora*
- B: *Dichromene ciliate* : inflorescence
- C: *Ficinia redlate* : inflorescence
- D: *Cyperus pulchellus* : whole plant
- E: *Cyperus pulchellus* : spikelet.

(4) *Cyperus pulchellus* R. Br. (Fig. 1.D and E)

Cyperus pulchellus is a small cormaceous perennial herb, native to tropical Australia. During a visit to the Mitchell Plateau, N.W. Kimberley in February 1980, the author was able to observe the pollination of this species. In this region *Cyperus pulchellus* is commonly encountered on shallow loamy soil on, or edging basaltic outcrops. During the wet season the soil here is either saturated with water or submerged under several centimetres of running fresh water. Flowering occurs between January and April. It appears that *Cyperus pulchellus* (voucher, GK 2471)* is invariably associated with *Eriocaulon* sp. (GK 2679, Eriocaulaceae) which forms dense mats in the same habitat. *Eriocaulon* also has an inflorescence which is superficially very similar to *Cyperus pulchellus* (a dense, vivid white, pom-pom like inflorescence). Unlike *Cyperus pulchellus* (which lacks nectaries) the flowers produce nectar and are sweetly scented. *Eriocaulon* is also much reduced in stature compared to *Cyperus pulchellus*.

Both species are visited by a suite of small bees (collections destroyed in transit, due to cyclonic rains) which collect nectar and pollen from the more abundant *Eriocaulon*, and pollen from *Cyperus pulchellus*. A few supplementary observations were made during April, 1982 when only scattered plants of *Cyperus pulchellus* were flowering in wetter localities edging creeks. In these creeks *Eriocaulon setaceum* L. (GK 4648) was flowering profusely and was being visited and pollinated by small black flies (currently being identified and catalogued at the C.S.I.R.O. Australian National Insect Collection). These flies were also rarely found probing inflorescences of nearby *Cyperus pulchellus*, suggesting that flies may also be involved in pollination of this species but further observations are needed.

Cyperus pulchellus is highly protogynous, the stigmas being completely withered before the anther dehisces, and automatic self pollination cannot occur. Plants cultivated at Kings Park, are self fertile, in the sense that viable seed is formed when flowers at the female stage are pollinated using pollen from adjacent flowers at the male stage. In wild populations bees tend to collect pollen by combing anthers all over the inflorescence before moving on, hence a considerable amount of self pollinations must occur.

(5) Another sedge *Rhynchospora affinis* W.V. Fitzg. (GK 2666)* was regularly probed by small yellow butterflies (*Eurema* sp). These butterflies were also visiting *Mitrasacme* (Loganiaceae) and *Borreria* (Rubiaceae) at the same locality, Mitchell Plateau airstrip. Cultivated material of this species does not produce any detectable nectar, and I was unable to detect any reason for this behaviour. These butterflies carry *Rhynchospora* pollen on their proboscises, but only in small amounts, and their role as actual or potential pollinators require further studies.

DISCUSSION

Cyperus pulchellus flowers during the wet, unlike most other sedges (Fig. 2) occurring in this region. In general wind pollinated species grow during the wet and flower as the dry commences (this is also true for the grasses - flowering times for each species given in Keighery, 1983). This is because pollen transference by wind is often not possible during the wet due to high humidity levels or rain. In the desert, flowering is more sporadic whereas in the southwest it is concentrated in spring and early summer, again missing the rainy periods.

Perhaps because of its small stature, and limited habitat range *Cyperus pulchellus*, must flower before it can be overtopped by the annual grasses (especially *Eriachne pauciflora* R.Br) which dominate these basaltic sheets by the end of the wet. By this time competition for water and nutrients would be intense in these shallow soils. However, to flower and seed while nutrients and water are readily available *Cyperus pulchellus* has to cope with unfavourable re-adoption of insect pollination has occurred.

Cyperus pulchellus has not developed large attractive bracts, as appears normally the case for other insect pollinated Cyperaceae, but has vivid white coloured glumes. This gives the species a white pom-pom inflorescence superficially like the more abundant (and for the insect more rewarding) *Eriocaulon* species of the same habitat.

No other species of Western Australian Cyperaceae has other than green or

* vouchers lodged in the W.A. Herbarium (PERTH)

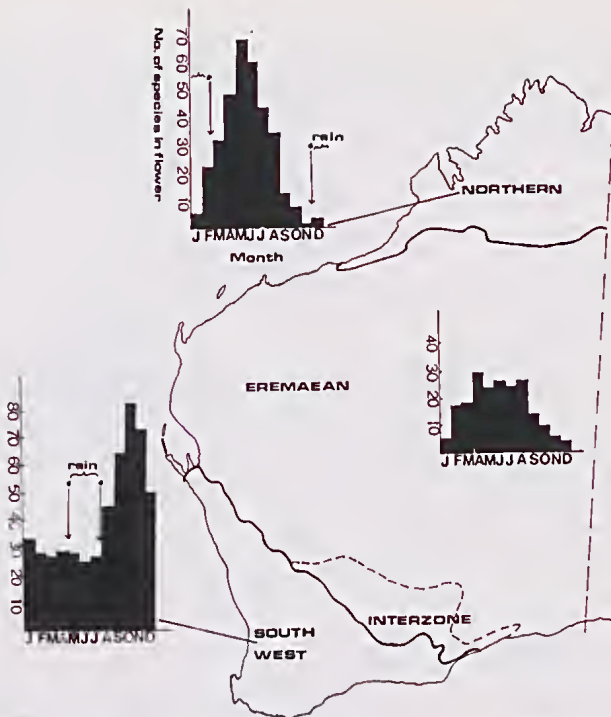


Figure 2. Flowering histograms (no. species in flower per month) of Western Australian Cyperaceae, distributed according to Botanical Provinces. (Data from herbarium specimens, summarized in Keighery, 1982).

brown inflorescences, despite some commencing flowering during the wet (most species extending well into the dry season). *Cyperus pulchellus* appears to have a unique pollination system for any species in this state.

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